A Study on the Innovative Integration of Information Technology and Primary School Classroom Teaching

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Abstract. With the popularization of information technology, information science and technology have become key to the modernization of education. This study aims to explore the deep integration of information science and technology into primary school classroom teaching, emphasizing its nature beyond mere technological application and the seamless and efficient interaction it facilitates. Innovation pervades various aspects such as teaching technologies, tools, and concepts. Schools both domestically and internationally are actively adopting intelligent teaching systems, virtual reality, and other technologies to enhance teaching quality and student interest. Practice has shown that emphasizing technological adaptability, student-centered teaching strategies, and the transformation of teachers' roles not only enrich teaching content but also enhance students' autonomous learning and innovative capabilities. This demonstrates high potential for promotion and practical value, leading education towards a new era of transformation.

Keywords: Information Technology, Primary School Teaching, Teaching Integration, Innovative Practice

1 Introduction

With the rapid advancements in information technology, information science and technology have deeply penetrated the field of education, becoming an indispensable force driving the modernization of education. Educational informatization not only reshapes the ways in which educational resources are acquired, processed, and presented but also provides strong support for innovative educational models such as personalized learning, precision teaching, and collaborative learning. Primary school education, as a crucial part of basic education, is facing unprecedented challenges and opportunities in its classroom teaching. How to skillfully integrate information science and technology into primary school classroom teaching to enhance teaching effectiveness has become a hot topic in current educational research.

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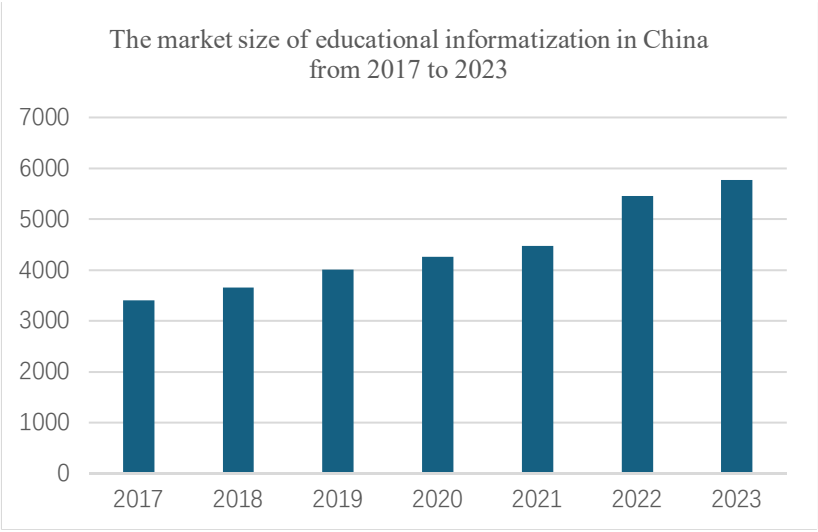

Fig. 1. The market size of educational informatization in China from 2017 to 2023 (in billions of yuan).

In recent years, emerging technologies represented by artificial intelligence, big data analysis, cloud computing, the Internet of Things, and virtual reality have emerged as powerful forces, injecting robust technological vitality into educational informatization. The introduction of these technologies has not only significantly improved the convenience of acquiring educational resources, the efficiency of processing them, and the diversity of presenting them but also brought unprecedented personalized learning experiences to students. Educational informatization is striding towards the construction of fully connected, fully (perceptive), and fully intelligent smart campuses, and its market size continues to grow. As shown in Figure 1, the market size of educational informatization in China has steadily expanded since 2017, reaching 543.1 billion yuan in 2023, indicating the accelerating trend of educational modernization.

In the current context, primary school classroom teaching is facing a series of challenges, such as how to meet the increasing personalized needs of students and how to effectively utilize limited teaching resources. The introduction of information technology undoubtedly provides a new perspective and solutions to these issues [1]. By skillfully utilizing information technology, we can not only greatly enrich teaching content and improve teaching efficiency, but also precisely meet the personalized learning needs of each student.

However, to achieve all this, deep and innovative integration is the core of combining information technology with primary school classroom teaching. Only through innovative integration strategies can we fully harness the enormous potential of information technology in the field of education, thereby leading primary school teaching towards new reforms and developments. This study aims to delve into how to achieve deep integration of information technology with primary school classroom teaching and

further explore its innovation. Specifically, we will focus on the following key questions: In what ways does the innovative integration of information technology and primary school classroom teaching manifest itself? And how can this innovative integration model be used to comprehensively improve teaching quality and student learning outcomes [2]?

We hypothesize that through deep integration of information technology, entirely new methods of primary school classroom teaching can be developed, effectively stimulating students' interest and enthusiasm for learning, and thus significantly improving teaching quality [3]. Our expected goals include: deeply exploring the best paths and methods for deep integration of information technology with primary school classroom teaching; comprehensively analyzing the significant improvements in teaching effectiveness after deep integration, as well as its profound impact on students' learning attitudes and abilities; and ultimately, proposing a series of innovative integration strategies and suggestions to provide strong theoretical support and practical guidance for primary school classroom teaching reforms. Through this study, we hope to profoundly reveal the innovative value of deep integration of information technology with primary school classroom teaching, as well as its broad application prospects in teaching practice, thereby contributing our wisdom and strength to promoting the modernization and informatization process of primary school education.

2 Analysis of Deep and Innovative Integration

2.1 Definition of Deep and Innovative Integration

Deep integration is not a simple application of technology at the teaching level; rather, it represents a close and highly synergistic combination between information technology and primary school classroom teaching. This integration aims to break away from traditional teaching methods and strive for diversification of teaching content, innovation in teaching methods, and modernization of teaching means. The core of deep integration lies in the mutual promotion of education and technology, aiming to construct a new teaching mode that meets the needs of the digital era. The connotation of deep integration is to comprehensively and deeply reform primary school classroom teaching with the powerful force of information technology. This not only means that teaching content will become more vivid and image-based, but also that teaching methods will be more flexible and varied. At the same time, students' learning experiences will be unprecedentedly enhanced. Its extension widely touches upon various areas such as digitalized teaching management, networked teaching resources, and intelligent teaching evaluation, all of which are goals and directions pursued by deep integration.Figure 2 illustrates the flowchart of the deep integration of information technology and primary school classroom teaching, presenting a clear path of collaborative evolution across teaching content, methods, and evaluation supported by technology.

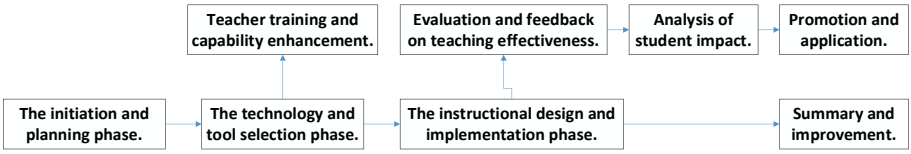

Fig. 2. Flowchart of Deep Integration of Information Technology and Primary School Classroom Teaching

Innovation is the soul of deep integration. It is not only manifested in the innovation of teaching technologies and tools, but also in the comprehensive innovation of teaching philosophies, instructional designs, and teaching evaluations. For example, with the help of big data and artificial intelligence technologies, teachers can provide more precise and personalized learning paths for students; through advanced technologies such as virtual reality and augmented reality, students can engage in more realistic and immersive simulated experiments and inquiry-based learning. These are vivid manifestations of innovation in the process of deep integration.

2.2 The Current Status of Deep Integration of Information Technology and Primary School Classroom Teaching

Driven by the wave of digitization, the deep integration of information technology and primary school classroom teaching has become an irreversible trend in the field of education. More and more schools and educational institutions are actively exploring how to organically integrate information technology into classroom teaching to improve teaching quality, stimulate students' interest in learning, and comprehensively cultivate students' information literacy and innovation ability[4].

From many domestic and foreign practice cases, we can see the significant effect of deep integration. For example, in Zhiduo County Primary School in Qinghai Province, the use of AI teaching assistant robots has significantly improved the effect of language teaching. The accuracy rate of teachers' pronunciation correction has increased by 87%, students' Putonghua oral test scores have increased by about 15 points, and the accuracy rate of English follow-up has increased by 22%.

Similarly, Guizhou Province's Mushan primary school has introduced an adaptive learning system based on artificial intelligence to support personalized teaching. After one semester, the average grade of the class has increased by 10.65%, and 15.2% of the students with poor grades have reached the average level of the class.These quantitative results show that AI driven technology is particularly effective in improving accuracy, student performance and personalized learning outcomes. See Table 1 for a summary and comparison of the teaching improvement in the two schools.

Table 1. Comparative data on learning outcome improvements from AI integration in primary schools

Case School	Tech Type	Average Score↑(%)	Oral Test↑(pts)	Pronunciation Accuracy↑ (%)	English Reading Accuracy↑ (%)	Underperformer Catch-up↑ (%)
Zhiduo (Qinghai)	AI Assistant	7.5	15	87	22	12.5
Mushan (Guizhou)	AI Adaptive	10.5	8	60	18	15.2

2.3 The Value of Innovation in Deep Integration

Despite the significant achievements of deep integration in enhancing teaching effectiveness and promoting comprehensive student development, some issues have emerged in practical applications. For instance, some teachers struggle to effectively utilize new technologies for teaching due to a lack of necessary information technology literacy. Additionally, there is an uneven distribution of teaching resources, with certain regions and schools unable to achieve deep integration due to limitations in funding and equipment [5].

Innovation is crucial in addressing these challenges. It not only drives the renewal of teaching philosophies and improvements in teaching methods but also stimulates students' enthusiasm for learning and creativity, cultivating their autonomous learning and collaborative skills. Through continuous innovation and practice, we can continuously explore teaching models and methods that are more suited to the current educational environment. Deep integration and innovative teaching models provide strong support for improving teaching quality and efficiency [6]. With the help of information technology for refined management and personalized guidance of the teaching process, teachers can more accurately grasp students' learning needs and identify their problems, thereby offering more targeted teaching plans [7]. This not only helps improve students' learning outcomes but also effectively reduces teachers' workload, significantly enhancing teaching efficiency.

Under the guidance of deep integration and innovative teaching models, students will have access to a richer variety of learning resources and methods. Meanwhile, with careful guidance from teachers, students can autonomously explore knowledge and solve problems. This new approach to learning will contribute to the cultivation of students' information literacy and innovative capabilities while enhancing their autonomous learning and critical thinking skills. This undoubtedly has far-reaching implications for students' future learning and career development.

3 Strategies for Deep Integration of Information Technology and Primary School Classroom Teaching

3.1 Technology Selection and Adaptability Analysis

Primary school classrooms have unique characteristics, such as short attention spans, strong curiosity, and a love for hands-on activities among students. Therefore, when selecting information technology, these characteristics must be fully considered to ensure that the technology can effectively serve teaching. For example, using interactive multimedia teaching resources with bright colors and rich animation effects can attract students' attention and increase their interest in learning. At the same time, according to the needs of the teaching content, appropriate technological tools such as programming software and virtual reality (VR) technology should be selected to enrich teaching methods and enhance teaching effectiveness [8].

The matching degree between technology and teaching content is key to deep integration. Teachers need to deeply analyze the teaching content, clarify teaching objectives, and select information technology tools that match them. For instance, when explaining astronomical knowledge in science courses, virtual reality technology can be used to allow students to observe the starry sky immersively, thereby deepening their understanding of astronomical phenomena. Another example is in language learning, where speech recognition and artificial intelligence technology can be utilized to assist students in oral practice and pronunciation correction.

3.2 Deeply Integrated Teaching Strategies

In the deeply integrated instructional design, the focus should always be on students, paying attention to their learning needs and interests. By creating authentic learning situations, students are guided to actively explore and collaborate, thereby cultivating their autonomous learning abilities, critical thinking, and innovation capabilities. For example, in math class, game-based learning tasks can be designed using information technology to help students grasp mathematical concepts and problem-solving skills through gameplay. At the same time, students are encouraged to use information technology tools for autonomous learning and exploration, such as searching for resources through online databases or solving math problems using programming software.

Information technology provides strong support for personalized learning. Teachers can collect student learning data through intelligent teaching systems, analyze students' learning characteristics and needs, and customize personalized learning paths for each student. For instance, based on students' learning progress and ability levels, learning resources and exercises of corresponding difficulty can be pushed to them; artificial intelligence technology can be utilized to provide personalized learning feedback and suggestions to students. This approach can better meet students' learning needs and improve learning outcomes [9].

3.3 The Transformation of Teachers' Roles and Enhancement of Their Capabilities

In the deeply integrated teaching mode, the role of teachers has undergone profound changes. Teachers are no longer mere transmitters of knowledge, but rather guides and facilitators in the learning process of students. They need to utilize information technology to create diverse and enriching learning situations, stimulating students' interest and desire for exploration. At the same time, teachers must pay attention to individual differences among students and provide personalized guidance and support to each one. Furthermore, teachers need to continuously learn and master new information technology tools and teaching concepts to adapt to the needs of the developing times [10].

Enhancing teachers' information technology application abilities is a crucial guarantee for achieving deep integration. Schools can provide systematic training on information technology application for teachers through organized workshops, seminars, online learning, and other means. The training content should cover various aspects such as basic knowledge of information technology, operation of teaching software, and instructional design concepts. At the same time, teachers are encouraged to actively explore and try out new information technology tools and teaching methods in their teaching practice, continuously improving their information technology application abilities through reflection and summarization [11]. Additionally, schools can establish platforms for the exchange of information technology applications to promote experience sharing and cooperative exchanges among teachers, jointly driving the in-depth development of deeply integrated teaching.

4 The Presentation Mode of Deeply Integrated Information Technology and Primary School Science

4.1 Multimedia-assisted Instruction

Multimedia-assisted instruction enriches teaching content greatly and makes it more vivid and intuitive by skillfully integrating various media forms such as text, images, audio, and video. This advantage is particularly prominent in primary school science teaching. Teachers can fully utilize multimedia resources, such as displaying animal behaviors, plant growth processes, and natural phenomena, to present a colorful scientific world to students. This teaching method not only attracts students' attention but also effectively helps them better understand and grasp those originally abstract scientific concepts.

Interactive whiteboards, as one of the important tools for the deep integration of information technology and primary school science, have brought revolutionary changes to the classroom [12]. Take teaching earthquake-related knowledge as an example. Teachers can easily present multimedia information on key concepts such as magnitude, epicenter, and hypocenter through interactive whiteboards. Students can directly operate on the whiteboard, pointing out the locations of the epicenter and hypocenter, as well as the propagation directions of S-waves and P-waves. This interactive learning approach not only significantly increases student engagement but also makes

the originally complex concept of earthquakes intuitive and easy to understand, thereby further enhancing teaching effectiveness.

4.2 Network Resources and Online Learning Platforms

Network resources and online learning platforms have opened up a vast new world for primary school science teaching. Teachers can easily integrate high-quality educational resources from the internet, such as science websites, diverse video courses, and convenient online experiments, thereby greatly enriching students' learning content. At the same time, students can also fully utilize these platforms to autonomously choose learning content according to their interests and needs, achieving personalized learning and improving learning efficiency [13].

Online collaborative learning environments provide powerful support for communication and cooperation among students. Teachers can skillfully construct online collaboration platforms to organize diverse activities such as group discussions and collaborative task completion. This innovative teaching method not only effectively cultivates students' teamwork abilities but also greatly stimulates their innovative thinking and problem-solving skills. For example, in scientific inquiry activities, students can conveniently share experimental data online, engage in heated discussions about experimental results, and jointly tackle scientific problems, enjoying the joy of cooperative learning.

4.3 Virtual Experiments and Simulation Teaching

Virtual experiments and simulation teaching are significant achievements of the deep integration of information technology and primary school science, bringing students an unprecedented scientific inquiry experience. With the help of virtual experiment software, students can simulate various scientific experiments, observe experimental phenomena closely, and personally verify scientific principles. This innovative approach effectively compensates for the limitations and high safety risks of traditional experimental teaching, providing students with a safe, convenient, and enjoyable environment for scientific inquiry. For example, in biology teaching, students can use virtual experiment software to observe cell structures in depth and even simulate complex processes such as genetic recombination; while in physics teaching, students can intuitively understand abstract concepts such as mechanics principles and electromagnetic phenomena through simulation experiments [14].

The simulated experimental environment not only provides students with abundant experimental resources but also gives them valuable opportunities to explore scientific phenomena. In this virtual laboratory, students can freely operate experimental equipment, adjust experimental parameters, and carefully observe the changing patterns of experimental phenomena. This inquiry process not only helps cultivate students' observation, analysis, and problem-solving skills but also significantly improves their scientific literacy. At the same time, the simulated experimental environment can record students' experimental processes and results in real-time, providing teachers with objective

and comprehensive evaluation bases, which helps further optimize teaching strategies and improve teaching quality.

5 Successful Cases and Challenges in Practice

5.1 Successful Cases

With the rapid development of information technology, the deep integration of information technology and primary school classroom teaching has become a key way to improve education quality, enrich teaching methods, and promote the comprehensive development of students. (Hebi Heshan Primary School in Heshan District) has made active explorations in this field and achieved remarkable results.

The school deeply recognizes the importance of information technology for education modernization and has set a clear goal for the construction of a smart campus: to build an integrated, intelligent, and convenient teaching environment through information technology, providing teachers and students with high-quality educational resources and efficient learning management tools. Guided by this goal, the school has actively introduced advanced teaching equipment and software, successfully constructing a multimedia interactive teaching platform that combines online and offline teaching modes. This innovation not only makes classroom teaching more vivid and interesting but also greatly stimulates students' interest and initiative in learning.

In the process of deep integration, the school pays special attention to the transformation of teachers' roles and the innovation of teaching strategies. Teachers are no longer just knowledge transmitters but have become guides and facilitators in the learning process of students. They use smart teaching tools for personalized teaching, providing customized learning paths and resources based on students' learning characteristics and needs. This student-centered teaching strategy effectively improves teaching effectiveness and promotes the comprehensive development of students. At the same time, the school has also made significant progress in the intelligent management of campus. Through technologies such as big data and cloud computing, real-time collection, analysis, and display of various data within the campus are achieved. The application of equipment such as smart access control systems and smart monitoring systems has further enhanced the safety management level of the campus. The application of these intelligent means not only improves management efficiency and quality but also creates a safer and more convenient learning environment for teachers and students.

In terms of resource construction, the school fully excavates and utilizes high-quality resources both inside and outside the campus, building a teaching resource library and learning platform with its own characteristics. Through cooperation with other schools and institutions, resource sharing and utilization are achieved, providing teachers and students with richer learning resources and broader development space. Additionally, the school has strengthened teacher and student training and promotion work, helping them master the usage methods and skills of the smart campus, further promoting the deep integration of information technology and primary school classroom teaching.

After a period of construction and promotion, Longcheng No.5 Primary School in Longmen County has achieved remarkable results in the deep integration of information technology with primary school classroom teaching. The application of new smart teaching models has brought new vitality and energy to classroom instruction. The implementation of personalized teaching strategies has met the diverse learning needs of students. The enhancement of intelligent campus management has laid a solid foundation for the school's long-term development. These achievements have not only received unanimous praise and high recognition from teachers and students but also provided valuable reference and inspiration for other schools.

5.2 Challenges and Limitations

In the process of deep integration of information technology with primary school classroom teaching, while it has brought richness and innovation to teaching content and methods, it also faces a series of challenges. Firstly, students may become overly reliant on virtual experiments, online resources, and multimedia teaching tools, neglecting the importance of practical operations and hands-on experience. This dependence may adversely affect students' hands-on abilities and the development of practical skills, leading to a lack of effective problem-solving strategies when faced with real-world issues. To address this challenge, teachers should emphasize the importance of practical operations and personal experiences in the teaching process, encouraging students to combine online resources with hands-on experiments to cultivate their practical abilities and problem-solving skills.

Secondly, excessive reliance on technology may also weaken students' autonomous learning abilities and creativity. Students may become accustomed to directly obtaining answers through search engines and online resources rather than solving problems through their own thinking and exploration. To stimulate students' autonomous learning and innovative abilities, teachers need to design more challenging and inspiring questions, guiding students to engage in deep thinking and independent exploration. At the same time, through project-based learning, cooperative learning, and other methods, students can develop creativity and teamwork abilities in the process of solving problems. This innovative classroom model is vividly illustrated in Figure 3, which shows how the integration of intelligent classroom infrastructure and educational software creates an interactive and immersive learning environment, thereby enhancing students' engagement and teaching effectiveness.

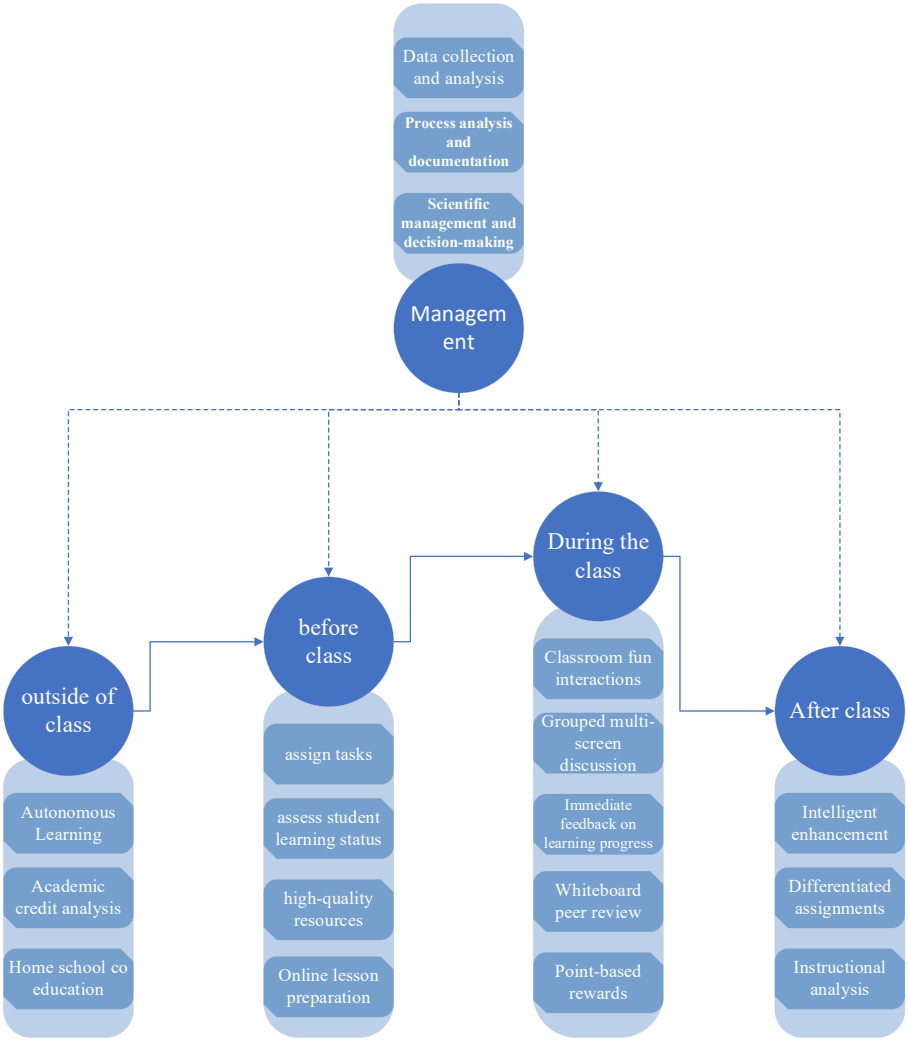

Fig. 3. Smart Classroom under Deep Integration

Furthermore, the deep integration of information technology with primary school classroom teaching also involves the issue of student data security. During the teaching process, sensitive data such as students' personal information, learning records, and behavioral trajectories are collected, stored, and analyzed. If the school's network security measures are not in place, these data may face the risk of leakage when transmitted in intelligent systems, posing serious legal risks and social issues for students and schools. To ensure the security of student data, schools should strengthen network security construction and data protection measures, regularly maintain and update network equipment, and simultaneously enhance cybersecurity education and training for teachers

and students to improve their awareness and prevention capabilities regarding network security [15].

Although the deep integration of information technology with primary school classroom teaching brings many advantages to teaching, it also faces challenges such as student dependency issues, decreased autonomous learning abilities, and data security. To overcome these challenges, schools, teachers, and students need to work together, focusing on practical operations and personal experiences, stimulating autonomous learning and innovative abilities, and strengthening network security construction and data protection measures. Only in this way can we achieve a true deep integration of information technology with primary school classroom teaching and promote the process of educational modernization.

6 Conclusion

In the era of rapid information technology development, this study explores the deep integration of information technology with primary school teaching. This integration marks a profound transformation in educational philosophies, methodologies, and ecosystems. Cutting-edge technologies such as multimedia, virtual reality, big data, and artificial intelligence have injected vitality into teaching, enriching teaching content and forms. Multimedia makes knowledge vivid and interesting, while virtual reality provides immersive experiences, enhancing understanding and curiosity. Big data facilitates personalized teaching, meeting diversified needs and improving teaching efficiency, which helps cultivate autonomous learning and critical thinking skills.

The role of teachers has shifted from knowledge transmitters to learning guides, requiring them to continuously learn and adapt. This transformation promotes teachers' professional growth and self-identity. Schools provide information technology training and resource support for teachers. However, challenges still exist, such as over-reliance on virtual resources and uneven teacher capabilities. Addressing these issues requires practical courses, optimizing resource allocation, and strengthening training.

In conclusion, the deep integration of information technology with primary school teaching is crucial for achieving educational modernization, improving educational quality, and fostering student development. Future research and practice will explore innovative models to contribute to cultivating talents with innovation and practical abilities.

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